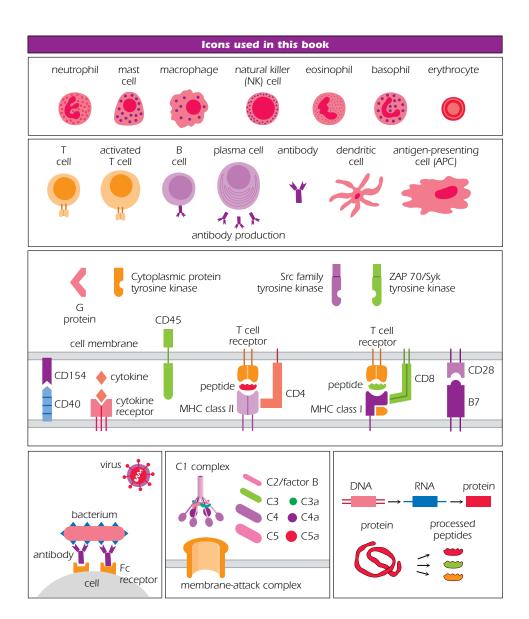
# IMMUNOLOGY A Short Course

FOURTH EDITION



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### **FOURTH EDITION**

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To Lisa, Jonathan, and Jennifer R.C.

To Ilene, Caroline, Alex, and Pearl G.S.

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## PREFACE AND ACKNOWLEDGMENTS

Since the last edition, significant developments in biomedical research have helped to refine and, in some cases, redefine our understanding of many aspects of the immune system. As a result, every chapter published in the fourth edition has been either updated or rewritten to incorporate new findings and to delete information that no longer reflects current thinking. In addition, several new chapters have been added to the book, including one on cytokines and another on resistance and immunization to infectious diseases. Finally, a new section on experimental systems has been added to Chapter 5. Describing how and why biomedical scientists utilize various experimental tools to investigate the complexities of the immune system is essential to a student's understanding of the subject of immunology.

As in the first three editions, we remain committed to the motto "less is more." Therefore, our objective in creating this edition has been to present what we consider to be the most pertinent material in a concise, palatable, and easily digestible fashion to the introductory student of immunology. Additional supportive material for students and course instructors can also now be found on a Web site (see below).

We are deeply indebted to Dr. Susan Gottesman, who contributed the chapter entitled, "Immunodeficiency and Other Disorders of the Immune System." We also thank Dr. Karen Yamaga, who updated the autoimmunity chapter. The important contributions of Dr. Patricia Giclas, who updated the complement chapter, and Dr. Arturo Casedeval, who added the new final chapter on resistance and immunization to infectious diseases, are also gratefully acknowledged.

Richard Coico would like to acknowledge the loving support of his family during the writing of this book. Their fortitude, inspiration, and enduring patience helped make the job an enjoyable adventure. Special thanks is extended to the following list of colleagues who generously provided their insightful scientific expertise and many helpful suggestions for the Fourth Edition: Drs. Ethan Shevach (NIH), David Margulies (NIH), Lloyd Mayer (Mount Sinai School of Medicine), Lakshmi Tamma (CUNY Medical School), Linda Spatz (CUNY Medical School), Laurel Eckhardt (Hunter College), Kathleen Barnes (Johns Hopkins School of Medicine), Soldano Ferrone (Roswell Park Memorial Institute), and Harriet Robinson (Emory University). Finally, he would like to thank his mentors, Drs. Ronald Curley, Susan Krown, Robert A. Good, and G. Jeanette Thorbecke, each of whom has greatly influenced his commitment and passion to the road taken.

Geoffrey Sunshine would like to thank Peter Brodeur (Tufts University Medical School) and Cindy Theodos (Tufts University Veterinary School) for their unstinting help during the preparation of his section of the current edition; they reviewed chapters in both the Third and Fourth Editions, and offered suggestions for making the material relevant and accessible to introductory readers. He is also grateful to the

many friends and colleagues who answered questions about their areas of expertise, especially Mark Exley, Susan Kalled, and Paula Hochman. In addition, he would like to thank his family for their continued support and understanding during the writing.

The authors wish to express their appreciation to the staff members of John Wiley and Sons, Inc., who helped to bring the Fourth Edition to publication and did so with skill, patience, and good humor. Special thanks to our co-workers, including secretaries, office assistants, and other staff members, who helped with the preparation of the manuscript.

Finally, we wish to acknowledge the important contributions made by Dr. Sidney Leskowitz to the earlier editions of this book. The Hypersensitivity chapters are dedicated to his memory.

#### IMMUNOLOGY: A SHORT COURSE ON THE WEB

The Web site is designed as an additional resource for students and educators who adopt the book for use in their courses (http://www.wiley.com/immuno-short course.com). The site uses WebCT, a versatile online course management tool. The following features are included in the Web site:

- · Table of contents
- Information about the authors
- · Sample chapter
- All figures and tables published in the 4th edition
- Icon page with downloadable clip art images
- Embellished and regularly updated CD Antigens and Cytokine tables
- Embellished and regularly updated Glossary
- Embellished and regularly updated Review Questions and Answers section
- · Links to other useful Web sites

The authors chose to use the WebCT course management tool because it is the undisputed e-learning leader in higher education. The Web site and its WebCT backbone allow those who adopt the 4th edition of **Immunology: A Short Course** to teach *their* courses *their* way.

We remain committed to updating the Web site regularly with the goal of facilitating the teaching efforts of instructors and, of course, student e-learning. First and foremost, our commitment in maintaining this Web site will be to provide an immunology-related educational resource that presents appropriate current information in a clear, concise, and student-friendly manner.

# PREFACE AND ACKNOWLEDGMENTS TO THE THIRD EDITION

Since the last edition, the intense efforts of research scientists around the world have produced significant new findings that have reshaped our understanding of many aspects of the immune system. As a result, every chapter in the current edition has been either updated or rewritten to incorporate new findings and to delete information that no longer reflects current thinking.

As in the first and second editions, we remain committed to the motto "less is more." Our task has been to present what we consider the most relevant material in a concise, palatable, and easily digestible fashion to the introductory student. That reader will be the best judge of whether we have succeeded.

We are deeply indebted to Dr. Demosthenes Pappagianis, who contributed the chapter on immunoprophylaxis and immunotherapy, and Dr. Karen Yamaga, who contributed the chapter on control mechanisms in the immune response and on autoimmunity. We wish to thank the many co-workers and students who contributed to the first and second editions and those who were helpful in the preparation of the third edition, in particular, Dr. Robert J. Scibienski of the School of Medicine, University of California at Davis, and Dr. Donna M. Rennick, DNA Research Institute, Palo Alto, California. Geoffrey Sunshine would like to thank the many friends who patiently answered his questions during the writing of the third edition, in particular, Peter Brodeur, Mark Exley, and Paula Hochman. He would also like to thank his family for their continued support: Ilene, for her encouragement and dedication to the cause, and Alex and Caroline, for their optimism. His sections are dedicated to his father Harry, who did not live to see the new edition.

## PREFACE TO THE SECOND EDITION

An anxiety common to authors of textbooks in rapidly developing fields is the necessity of relatively frequent revisions to include material that, in the previous edition, was in the "twilight zone," between fact and fancy but that since has gained the status of important fact. Indeed, the rapidly developing field of immunology requires continuous revisions; hence, the present edition.

In this second edition, various concepts and findings have been updated and expanded; new information has been added on such diverse topics as the molecular biology and genes controlling antibody synthesis and isotype switch, T-cell differentiation and the T-cell receptor, antigen processing and presentation, cytokines and lymphokines, new therapeutic approaches for immunodeficiency disorders and tumors, and new aspects of prophylaxis and immunotherapy of infectious diseases. In addition, we have added a section on AIDS and several techniques such as Western blots and fluorescence-activated cell sorting. We have also expanded the glossary and added review questions as well as several clinical correlates.

Although we have deleted and shortened some sections, the expanded and added material increased somewhat the size of the book. We can, however, assure the readers that with this second edition, as with the first edition, we remain committed to the motto "less is more" and have attempted to present the principles of immunology in a concise, palatable, and easily digestible form.

Revision and change is the constant burden that authors writing about a dynamically changing field have to carry. Students, too, have to partake of that burden and must prepare themselves with the realization that science is not static and they must continually move on to new levels of understanding. Good luck to us both.

## PREFACE TO THE FIRST EDITION

Why was this book written? At a time when so many excellent, extensive, and beautifully illustrated texts flood the bookstores, why offer another one? The reasons are fairly simple and rather unsophisticated. In our collective 40 some-odd years of teaching all kinds of students, we have become convinced that most texts fail their purpose because they overshoot the mark.

Anyone coming into contact with these students year after year cannot fail to appreciate the burden under which they operate. If they are to graduate, they must learn an enormous amount of material on an exceptionally diverse series of subjects, each increasing in scope yearly. As any student can tell you, every faculty lecturer considers his/her particular topic absolutely essential for future graduates, and so the pile of required "essentials" grows and grows. This is a manifestly untenable approach to curriculum.

A second cruel observation arises from long years of questioning students: many of them are not really that interested in immunology! As exciting, dynamic, and allencompassing in its passion that we practitioners of immunology find it to be, the students have many other interests and concerns, one of which is to pass the five or six other subjects usually taken simultaneously with immunology.

This book was therefore conceived along the lines of the noted architect Mies van der Rohe's dictum, "less is more." We have devised this text to present the bare essentials of immunology in a palatable form that will enable most students to grasp the essential principles of immunology sufficiently to pass their course. For those developing a deeper interest in the field, numerous advanced and more complete texts exist to further their interests.

The book follows the outlines of most immunology courses and is divided into chapters that mostly approximate the length of an average lecture reading assignment. A short introduction setting the stage precedes the main text of each chapter, the end of each chapter contains a summary, and a series of study questions appears at the very end. The questions are designed to enable students to evaluate their own progress and comprehension; the appended answers are meant as a further learning experience. As new terms or concepts are introduced, they are highlighted in italics and boldface and defined for easy recognition and recall.

It is our hope that students using this text will avoid that choking sensation so common in a course in immunology and even conceive a curiosity about the subject that will lead to further study.

# ACKNOWLEDGMENTS TO THE FIRST AND SECOND EDITIONS

The authors are deeply indebted to a number of colleagues and students for valuable contributions to the first and/or second edition of the book.

Dr. Demosthenes Pappagianis of the University of California School of Medicine at Davis contributed the chapter on immunoprophylaxis and immunotherapy, which provides useful, practical insights into the application of immunology to the prevention and therapy of infectious diseases.

Dr. Geoffrey Sunshine of Tufts University Veterinary School was deeply involved in the revision of many chapters of the second edition. His valuable and major contributions to the second edition are gratefully acknowledged.

Drs. Linda Werner and Jacqueline Maisonnave of the University of California School of Medicine at Davis and Drs. Peter Brodeur, Arthur Rabson, and Lanny Rosenwasser of Tufts University School of Medicine were most helpful in reading and contributing valuable suggestions to portions of the first edition. Many other colleagues reviewed portions of the text, and we are grateful for their criticisms and comments. These colleagues include Drs. James R. Carlson, Robert S. Chang, Allan C. Enders, Kent L. Erickson, Paul Luciw, Claramae H. Miller, and Robert J. Scibienski of the University of California School of Medicine, Davis; Drs. Dov Michaeli and Patricia R. Salber of the University of California School of Medicine, San Francisco; Dr. Shoshana Levy, Stanford University School of Medicine; Dr. Henry N. Claman, University of Colorado School of Medicine; Dr. Patricia Kongshavn, McGill University School of Medicine; and Dr. Karen M. Yamaga, University of Hawaii School of Medicine. Our apologies to other colleagues whose names have been unintentionally omitted.

Finally, we applaud the forbearance of our wives, Joy and Thelma, who continued to tolerate our irritability and whining during the writing of this book.